

USC Viterbi School of Engineering

AME 261 Basic Flight Mechanics

Units: 4

Term: Spring 2018 **Jan 8th – Apr 27th**

Location Lecture T/Th 10 – 11:50 am KAP 163
See course Blackboard and Piazza pages

Instructor Charles Radovich

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Office Hours T/Th 1-3pm

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Office Hours W 12:30-2:30 pm M 5-7 pm

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Course Description

Concepts and analysis methods regarding performance of flight vehicles; maximum speed, rate-of-climb, range, and endurance; basic stability and control, weight and balance; computer exercises.

Recommended Preparation: AME 105, AME 201, PHYS 151, Intro to computer programming

Textbook Anderson Jr., John D. Introduction to Flight, 7th Edition. McGraw-Hill. **(required)**
ISBN-10: 0073380245; ISBN-13: 9780073380247. (6th and paperback (intl.) editions ok)

Grading 20% Homework & Quizzes | 15% Design Project | 35% Final Exam
30% Three Midterm Exams (15% each, drop the lowest)

Discussion Board

This course will use Piazza for all class discussions. Refrain from emailing questions related to assignments, midterms, etc., and instead use Piazza. TA's, myself and even you can answer questions as they arise, thus providing an efficient means for communication. If you have issues accessing the Piazza, contact team@piazza.com directly.

Exams There will be three (3) Midterm Exams and one cumulative Final Exam, as noted in the schedule. Please note the exam dates on your calendar now. All exams will be closed notes unless stated otherwise.

Project A group **Design Project** will be initiated in the middle of the semester. Each group will be required to design several aspects of an aircraft within given constraints. Details will be discussed further during class.

Software **Matlab:** student license available at <http://software.usc.edu/>
MS-Excel: student license available at <https://itservices.usc.edu/officestudents/>
These programs are also available in all USC computer labs.

Calculator Required. Standard scientific calculators are allowed for use during all quizzes, midterms and the final exams. Programmable calculators and wireless devices (*e.g.*, cell phone, iPod/Pad, etc.) are not permitted.



Course Schedule

			Reading Assignments
1	Jan 9-11	Intro/Atmosphere/Continuity and Bernoulli equations	Ch. 3 - 4.5
2	Jan 16-18	Energy equation, viscosity, wings, Mach number and C_p	Ch. 4.6-9, 4.15-21 & 5.1-7
3	Jan 23-25	Induced drag, aircraft drag, propulsion	Ch. 5.12-24 & 9.1-6
4	Jan 30-Feb 1	E_{max} , V_{Dmin} and power requirements	Ch. 6.1-6 & 6.26
5	Feb 6-8	Altitude effects, climbing flight, ceiling and gliding flight	Ch. 6.7-10 & notes
6	Feb 13-15	Compressibility, Mach effects, wave drag and swept wing Midterm 1, Thu Feb 15	Ch. 5.7-12, 5.16 & notes
7	Feb 20-22	Range, optimum cruise altitude and endurance	Ch. 6.11-14 & notes
8	Feb 27-Mar 1	Cruise at different altitudes, speeds and angles of attack	Ch. 6.11-14 & notes
9	Mar 6-8	Takeoff performance	Ch. 6.15 & 5.17
10	Mar 13-15	Spring Break (March Madness)	
11	Mar 20-22	Landing performance Midterm 2, Thu Mar 22	Ch. 6.15-16
12	Mar 27-29	Turning flight	Ch. 6.17-23 & notes
13	Apr 3-5	Aircraft moments, stability criteria and partial derivatives	Ch. 7.1-6
14	Apr 10-12	Longitudinal static stability, effects of wings, tail and canards Midterm 3, Thu Apr 12	Ch. 7.7-12
15	Apr 17-19	Trim, stick free stability and lateral stability	Ch. 7.13-21 & notes
16	Apr 24-26	Misc. and review	
Final Exam Tuesday May 8 at 11am - 1pm			

Description and Assessment of Assignments

Homework will be assigned every week and will be due one week (*i.e.*, 7 days) after it is assigned. Approximately half of the homework will involve the use of a computer and will require graphical results. All students should be familiar with the university computer labs; alternatively, a personal computer can be used to solve the assignments. Homework will not be accepted late for unexcused reasons. A down computer is not a reason for late homework, neither is a faulty printer. Under no condition should you attempt to complete your assignment the night before it is due because most problem sets require more than one evening's work.

All assignments are due before the start of lecture. Late assignments will not be accepted. One microsecond (1 μ s) late is considered late and there are no exceptions. Physical documents must be handed in; electronic submissions will not be accepted. Absences for medical reasons must be justified with some verifiable evidence; first obtain doctor's note, then see me.

In order to receive credit for your work, all homework, quiz and exam problems must be presented in a clear, organized manner. Solutions must show evidence of work; "magic" answers will not be accepted. Partial credit may be given if the solution is presented in a logical fashion.

Students may work together on the homework by helping each other to discuss the problems, review the lectures, set up the problems, etc. **However, when you sit down to write a computer program or solve the homework problems, each student must do that individually.** You may also discuss each other's computer programs but **under no circumstances should you copy anyone's work.** **Do not share or email anything;** this goes for all courses at USC. **Failure to comply with this requirement will result in an F for the course.** All students should **read and understand** the **Academic Conduct** section of this document.

There are office hours throughout the week to help you with the course material; this time is best utilized when students come prepared with an attempt at a solution, thus allowing us to help you through your thought process.

There are no make-up assignments or exams. The lowest homework grade will be dropped from your total score; use this to your advantage if you have an upcoming schedule conflict. There are three midterm exams; the lowest midterm will also be dropped from your total. Everything else will count towards the final grade.

Homework Solutions – Rules and Tips

Technical communication is an extremely important skill required of all engineers. If you cannot present your work well to your boss or co-workers, do not expect a raise. Likewise, if you cannot present your technical work well in this class, you will not get a good grade on your assignments. Thus, all homework **must** be presented in a professional manner. Follow the guidelines below:

1. A hard copy of your work must be submitted in order to receive credit; scanned/faxed/emailed submissions **will not be accepted.** Print your name on each page of your homework and **staple** all pages together.
2. Homework is to be done on 8.5" x 11" paper **only**. Write on only **one side** of each page and be sure that mistakes are clearly erased or carefully crossed out so that anyone can read and follow your work without difficulty. If the grader cannot follow your logic or your work is messy, the homework will be returned to you ungraded and a score of zero recorded.
3. It is **necessary** that you present your work **neatly, logically** and **professionally**. To receive full credit on homework and exam problems **all** of the following **must** be shown:
 - a) Write down all given **data** at the beginning of the problem solution.
 - b) Include a **free hand sketch** of the problem whenever possible.
 - c) State the **assumptions** used in the problem.
 - d) Write the equations to be used in **symbolic form**. Indicate where you obtained the equations and verify that the assumptions embedded within the equations are consistent with the problem you are attempting to solve. Manipulate the equations in **symbolic form** to obtain the desired form **before** substituting in the numerical values (see example problems 4.3 and 4.4 in your book). **No exceptions!**
 - e) **Algebraic steps** are an important part of your work and should be shown. Again, no exceptions.
 - f) Work through the **Units** in your calculations and show conversion of the units as needed. Be sure to give **BOTH THE NUMERICAL VALUE AND THE UNITS** in your answer. Why? Because $4 \neq 4 \text{ m/s}$.
 - g) Round off the final numbers and report only **Significant Digits** consistent with the accuracy of the data (*i.e.*, if the data are given to 3 significant digits, **DO NOT** present an answer with 8 significant digits). If some of the data have only one digit given, *e.g.* angle of attack $\alpha = 8$ degrees, you should assume that two digits are implied (*i.e.*, $\alpha = 8.0^\circ$). In this case, your answer should contain only two significant digits although three significant digits will be accepted. Generally, you should have three significant digits in your answer unless you can justify more or less based upon the given data.
4. Remember that the most important aspect of homework and exam solutions (typically 80-90% of the grade for the problem) is **the method** and not the correct answer. Thus, indicate how the solution was obtained by showing each step in the solution and where the data were acquired.
5. Place a box around your answer to clearly indicate your final answer.

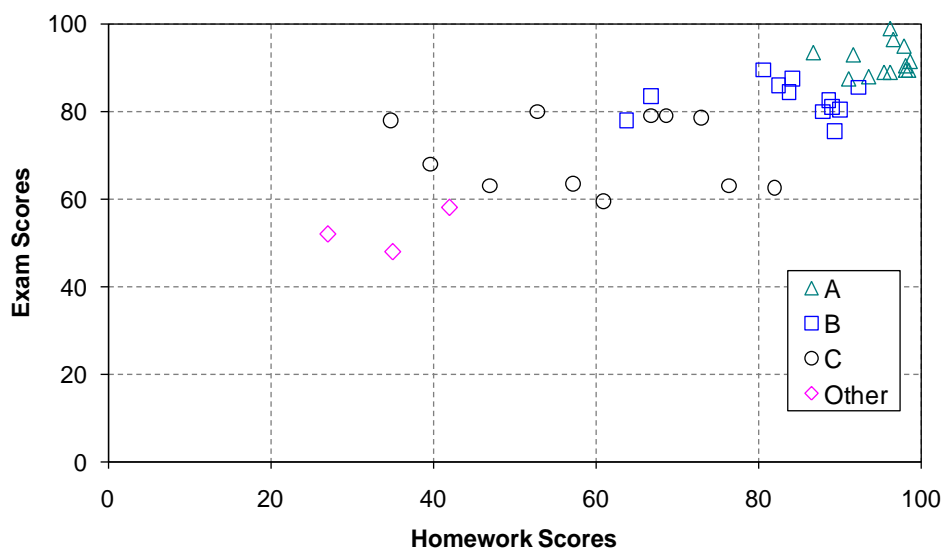


Figure 1. Correlation between Homework and Exam scores

Figure 1 is provided above to show the relationship between the homework scores (normalized to 100 points) and the grades on the exams. This data is from a previous semester but the trend is consistent year after year. Note that there is a strong correlation between how well students do on their homework and their exams; do not think that the homework is inconsequential. If you are having trouble, seek help either by seeing the instructor, the teaching assistants or get additional tutoring (Viterbi Academic Resource Center). Secondly, data over the past several year's shows that about one third of the students in the class earn an A, one third earn a B and the remaining third earn a C or lower. Lastly, looking at the individual homework scores (not shown), the lower scores were primarily due to students not submitting several of their assignments; it was not because they did poorly on all of their assignments. **Hence, be sure that you complete, understand the concepts within and turn in ALL of your homework if you want an A or B in the course.**

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/b/11-00-behavior-violating-university-standards-and-appropriate-sanctions/>, and **view the guidelines in Appendix A at the end of this document.** Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

Support Systems

Tutoring is available for this course through <http://viterbi.usc.edu/VARC/>. A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* <http://dsp.usc.edu/> provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Appendix A: Academic Dishonesty Sanction Guidelines

Violation	USC - Recommended Sanction for Undergraduates*	AME - Recommended Sanction for Undergraduates and Graduates
Copying answers from other students on any course work.**	F for course.	First offense: F on assignment. Second offense: F for course.
One person allowing another to cheat from his/her exam or assignment.	F for course for both persons.	If assignment: First offense: F on assignment. Second offense: F for course. If exam: F for course.
Possessing or using material during exam (crib sheets, notes, books, etc.) which is not expressly permitted by the instructor.	F for course.	First offense: F on exam. Second offense: F for course.
Continuing to write after exam has ended.	F for course.	F on exam
Taking exam from room and later claiming that the instructor lost it.	F for course and recommendation for further disciplinary action (possible suspension).	F for course
Changing answers after exam has been returned.	F for course and recommendation for further disciplinary action (possible suspension).	F for course
Fraudulent possession of exam prior to administration.	F for course and recommendation for suspension.	F for course
Obtaining a copy of an exam or answer key prior to administration.	Suspension or expulsion from the university; F for course.	F for course
Having someone else complete course work for oneself.	Suspension or expulsion from the university for both students; F for course.	F for course
Plagiarism — Submitting other's work as one's own or giving an improper citation.	F for course.	First offense: F on assignment. Second offense: F for course.
Submission of purchased term papers or papers done by others.	F for course and recommendation for further disciplinary action (possible suspension).	F for course
Submission of the same assignment to more than one instructor, where no previous approval has been given.	F for both courses.	F for both courses
Unauthorized collaboration on an assignment.	F for the course for both students.	First offense: F on assignment. Second offense: F for course.
Falsification of information in admission applications (including supporting documentation).	Revocation of university admission without opportunity to reapply.	Revocation of university admission without opportunity to reapply.
Documentary falsification (e.g., petitions and supporting materials; medical documentation.)	Suspension or expulsion from the university; F for course when related to a specific course.	Suspension or expulsion from the university; F for course when related to a specific course.
Plagiarism in a graduate thesis or dissertation.	Expulsion from the university when discovered prior to graduation; revocation of degree when discovered subsequent to graduation.***	Expulsion from the university when discovered prior to graduation; revocation of degree when discovered subsequent to graduation.***

*Assuming first offense

**Exam, quiz, tests, assignments or other course work.

***Applies to graduate students